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An evaluation of destination attractiveness for nature-based tourism: Recommendations for the management of national parks in Vietnam

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Abstract

National parks are increasingly recognized as playing an important role in the development of nature-based tourism destinations that promote effective management of natural resources and socioeconomic development. The paper was designed to evaluate the tourism attractiveness and performance of national parks in Vietnam. The tourism performance of 30 Vietnamese national parks was evaluated using multiple criteria decision analysis with the stochastic multicriteria acceptability analysis (SMAA) and preference ranking organization method for enrichment evaluation (PROMETHEE) method; thirteen national park attributes were used to determine tourism attractiveness, measured by an exponential weighted acceptability index. It was found that the Phong Nha – Ke Bang, Cuc Phuong, and Ba Be National Parks were most attractive for more than 95% of all possible preference structures. In addition, 12 non-dominated national parks were identified, and for an average supporter of most non-dominated protected areas, the trail criterion appears to be the most important. A statistically significant correlation was found between tourism attractiveness and the number of tourists who visited national parks. Our findings offer potentially useful information for decision makers in developing effective tourism marketing and management strategies for national parks in Vietnam.

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Keywords
National park, nature-based tourism, PROMETHEE, SMAA, tourism attractiveness, Vietnam

Introduction

Nature-based tourism (NBT), also known as ecotourism or nature tourism, defined as travel to enable the enjoyment of undeveloped natural areas, is a rapidly-expanding area in the tourism travel sector (Luzar et al. 1995, Goodwin 1996). Most nature-based tourism destinations are located in protected areas (Eagles et al. 2002, ICEM 2003, Spenceley et al. 2015) which attract large numbers of visitors: globally, terrestrial protected areas receive approximately eight billion visits per year (Balmford et al. 2015) and European national parks receive more than two billion visits annually (Schägner et al. 2016). Despite having a potentially negative influence on natural resources, affecting both the environment and the species within them (Steven et al. 2011), NBT could be a particularly effective tool in the conservation and management of protected areas. It can also bring potential social and economic benefits, such as funds for conservation and alternative livelihoods for local people (Bookbinder et al. 1998, Eagles et al. 2002, Balmford et al. 2009, Ballantyne et al. 2009). Many countries promote NBT in order to help them achieve their goals for both nature conservation and socioeconomic development, and for several countries such as Australia and New Zealand, NBT is considered a key component of export income (Eagles 2002)

In the Southeast Asia region, NBT is not only a high volume sector but also one that is growing rapidly. For example, Thailand's national parks receive over 13.2 million tourists per year, which is approximately 16% of all tourists visiting the country (Phumsathan 2010), and Indonesia's Komodo National Park sees an 18% mean increase of visitors every year (Erb 2015). For foreign tourists visiting the region, many countries such as Thailand and Vietnam have become popular destinations for NBT because they harbor extraordinary levels of ecosystems and magnificent natural scenery (American Museum of Natural History 2003). In contrast to general items of tourism activity, foreign tourists tend to be more interested in nature-based activities: about 51% of surveyed foreign tourists visiting the Association of Southeast Asian Nations (ASEAN) preferred nature-based adventure tourism (ASEAN Secretariat 2016).

In Vietnam, NBT is increasingly recognized as playing an important role in national development, particularly of the national tourism sector, and one that supports socioeconomic development in the rural areas surrounding the protected areas. Around 51% of the 9.5 million domestic tourists and 33% of 1.2 million foreign tourists in Vietnam took part in nature-based tourism in 1998 (Luong 1999), and 5–8% of foreign tourists visiting the countryalso participate in nature-based tours every year (Le Van Minh 2016). Innovation policies highlight the significant efforts made by the Vietnamese government to promote the development of NBT. In particular, the introduction of economic and political reforms under *Đổi Mới* has helped the tourism sector develop from scratch since 1986. The first master plan of tourism development, for the period 1995–2010, released in 1994, mentioned the potential for natural resources to

increase tourism; following this, NBT emerged officially as an important driving factor behind tourism development. The master plan up to 2020 views NBT as one of the key products of tourism contributing to national development (GoV 2013). In total, the Vietnamese government and their related bodies, public and private interests, domestic and foreign corporations, as well as local communities, are involved in various ways to enhance the development of NBT (Suntikul et al. 2010). However, Vietnam suffers from a lack of planning or strategies on the national level regarding NBT. National planning is also crucial in the management and development of NBT destinations such as protected areas, which enhance the country's tourist attractions, including its natural environments, biodiversity, cultures and ancient history (Jansen-Verbeke and Go 1995, Hung 1998, Hong et al. 2002, Le Van Minh 2016).

Vietnam's national parks (NPs) are protected areas in the national systems of special-use forests (SUFs), which are intended to protect nature. Other objectives include the protection of landscapes, cultural and historical sites, and the provision of recreation and tourism (GoV 2010). Since the first Vietnamese NP (Cuc Phuong NP) was established in 1962, their number had increased to 30 (1,077,236 ha, reaching ca. 3% of the total land area) by 2012 (MONRE 2014). According to the approved national planning system of SUFs, Vietnam will have 34 NPs up to 2020 (1.2 million ha, reaching ca. 4% of the total land area) (GoV 2014). The increasing number of NPs supports the conservation and sustainable development of natural resources in the SUFs (GoV 2014). Several ministries and agencies are involved in the governance of the protected areas; for example, the Ministry of Agriculture and Rural Development (MARD) and Provincial People's Committee (PPCs) have the responsibility for managing national parks (see An et al. 2018). In particular, together with MARD, the Ministry of Culture, Sport and Tourism guides and examines PPCs in the management of eco-tourist activities and promotes NPs as tourism destinations in the development of the tourism sector at a national level.

An area with special potential to acquire financial sources of funding for natural resource management in Vietnam is the use of NBT in NPs (An et al. 2018), which has been found to create alternative livelihoods for local people and support local socioeconomic development (Rugendyke and Son 2005, MONRE 2014). Effective protected area management encourages the expansion of benefits from NBT, particularly in the economic sphere (An et al. 2018) and NPs are attractive destinations for recreation and tourism. The total number of tourists visiting 11 NPs increased by over 17% in a single year, reaching 629,961 in 2010 (MONRE 2011). However, NBT is a competitive market and NPs have to offer high quality and unique environmental characteristics to succeed in tourism development. Many NPs suffer from a lack of any tourism development strategy in their management plans (An et al. 2018), and tourism facilities and services of protected areas (e.g. information services) are also limited (ICEM 2003). It is important to consider the characteristics of NPs and their potential value as attractive destinations for tourism development when implementing effective management strategies for protected areas and tourism, and encouraging the sustainable use of natural environment and resources. Protected area managers need to identify the attributes of NPs that induce tourism and set priorities for enhancing the

attractiveness of tourist destinations and increasing the tourist flow to protected areas. Furthermore, an evaluation of the attributes of individual NPs, and of other tourism destinations in protected areas, is required to form the basis of local, regional and national strategic planning for NBT development, to enable effective management and planning of nature-based tourism destinations, sustainable tourism and socioeconomic development in the country.

The attractiveness of a travel destination is simply the ability of an area to attract and satisfy prospective tourists (Mayo and Jarvis 1981). This ability is enhanced by destination attributes, which can be classified in a variety of ways (e.g. see Cooper et al. 1993, Buhalis 2000, Morrison 2013). Two major approaches can be used to identify improvements to destination attractiveness that focus on the physical features of the destination (e.g. Leiper 1990, Backman et al. 1991) or the psychology of consumers/tourists and the perceived ability of destinations to satisfy their individual needs (e.g. Formica and Uysal 2006, Hsu et al. 2009). These approaches are also known as supply and demand aspects for evaluating the attractiveness of tourism destinations (Backman et al. 1991, Formica and Uysal 2006). However, most nature-based studies focus on tourist demand rather than on tourist destinations (Deng et al. 2002). Therefore, the present study examines the supply of destinations as characteristics of NPs, with respect to tourism attractiveness. It is necessary to identify the attributes that prompt tourists to choose one destination over another. This knowledge could help destinations to allocate resources and prioritize the investment and development of their tourism areas, and enable such destinations to fulfill and retain their potential. Determining and evaluating the attributes of a destination that play key roles in attracting and satisfying tourists is also integral to its management and marketing policy, particularly those oriented towards tourism strategies and plans to target markets (Buhalis 2000, Kim and Perdue 2011).

Furthermore, different strategies for tourism destinations can be evaluated by the broad application of multiple criteria decision support methods such as the Analytic Hierarchy Process (AHP) (Deng et al. 2002, Hsu et al. 2009, Lee et al. 2010) or the preference ranking organization method for enrichment evaluation (PROMETHEE) (Michailidis and Chatzitheodoridis 2006, Kovačić 2010, Ranjan et al. 2016). During the decision-making process, decision makers rank a set of decision alternatives with multiple criteria and choose the best, or at least a satisfactory, choice according to their preferences. In most multiple criteria decision methods, the preferences of the decision maker are modeled by a set of parameters, with a key role being played by the weight given to each criterion. However, in many real-life situations, decision makers are not able to give exact preference information (weights), nor is it possible to gain access to the decision makers to collect information about their preferences. Most of the associated information is uncertain or imprecise to a certain degree, and even relevant information can sometimes be missing (Lahdelma et al. 2000, Öztürk et al. 2005, Ranjan et al. 2016). In addition, when evaluating the attractiveness of tourism destinations, it can also be difficult to obtain weights when no single decision maker exists who could provide the necessary information, and in cases where the preferences of all potential decision makers (e.g. tourists) must be considered.

In these cases, stochastic multicriteria acceptability analysis (SMAA) can be used, this being a family of multicriteria decision-aiding (MCDA) methods for problems where uncertainty (incomplete, imprecise, and uncertain information) is a significant issue (Tervonen and Figueira 2008, Lahdelma and Salminen 2010). In contrast to the classical MCDA method, the SMAA method considers the evaluation space of all possible parameters (in the context of weights) (Lahdelma et al. 1998), which determines the significance of the percentage contribution of all possible weight combinations to a particular object specific rank. In particular, it indicates the most preferred combination, based on rank acceptability index (Lahdelma and Salminen 2001).

The aim of this paper is to explore the attributes associated with tourism attractiveness, and evaluate the tourism performance of national parks in Vietnam using stochastic multicriteria acceptability analysis. More specifically, it assesses various attributes of NP-based tourism destinations and ranks NP destinations. The attractiveness of Vietnamese NPs as nature-based tourism destinations is evaluated by the SMAA and PROMETHEE methods. In addition, the correlation between tourism attractiveness and the number of tourists visiting NPs is assessed. The paper also discusses recommendations for NP management, particularly with regard to the attractiveness of nature-based tourism.

Materials and methods

Selection of attributes for evaluating the tourism attractiveness of national parks

Various attributes associated with specific types of tourist destinations influence the motivation to visit a NP and to enjoy it. In other words, the park in this sense is best viewed as a package of tourism facilities and services, composed of a number of multidimensional attributes that together determine its attractiveness to a particular individual in a given choice situation. Deng et al. (2002) group these attributes into the following five general categories: (1) tourism resources, (2) tourist facilities, (3) accessibility, (4) local communities, and (5) peripheral attractions. The unique attributes determining the attractiveness of a forest-based destination include the variety of natural resources, the diversity of cultural and historical assets, the availability of supporting tourism infrastructure, and the provision of information services and convenience facilities (Lee et al. 2010).

In the conceptualization described above, thirteen attributes (criteria) were selected to evaluate the attractiveness of 30 NPs in Vietnam (Figure 1, Table 1). The criteria were derived from previous studies regarding the tourism attractiveness of protected areas (e.g. Deng et al. 2002, Puustinen et al. 2009, Lee et al. 2010, Castro et al. 2015). The biological diversity and presence of rare species of plants and animals indicate the value of the natural resources or natural characteristics of a destination (Deng et al. 2002), which are considered the primary elements of its attractiveness (Lee et al. 2010). In addition, historical, cultural and spiritual sites within NPs constitute the cultural resources of a tourism destination (Deng et al. 2002, Lee et al. 2010). Other criteria

Figure 1. Distribution of the thirty Vietnamese national parks. Source: Adapted to IUCN and UNEP-WCMC (2017).

reflect the managerial and social characteristics of NPs towards tourism attractiveness. For example, amenities such as lodging (e.g. hotels) and recreation facilities (e.g. trails) allow tourists to satisfy their basic needs (Lee et al. 2010). The provision of such services is recognized as playing a significant role in encouraging tourists to partake in the

Table 1. Attributes for determining tourism attractiveness Vietnamese national parks.

Attribute	Description
International importance	Were the national park or national park areas specified under international designations (Ramsar Site, United Nations Educational, Scientific and Cultural Organisation World Heritage Sites and United Nations Educational, Scientific and Cultural Organisation Biosphere Reserve), yes/no?
Biodiversity of plants and animals	Number of species of plants and animals recognized in the national park
Rare plants and animals	Number of species of plants and animals recognized in the national park that listed in the 2007 Vietnam Red Data Book
Historical, cultural and spiritual structures	Were the national park or national park areas nationally-recognized notable historical, cultural and spiritual sites or structures, yes/no?
Hotels & hostels	Number of beds in accommodation service
Trails	Signposted paths and nature trails in kilometers
Information services	Number of available information services offered (7 in total) (guided walks, botanic garden, museum, tourism service office, environmental education center, center for rescue, creature conservation and development, interpretive/ informative boards)
Tourism cooperation	Number of enterprises contracting/linking the national park for tourism activities offered
Education & research cooperation	Number of domestic and international organizations/institutes that cooperate with the national park in research and educational fields
Diversity of outdoor activities	Number of available recreational activities offered (13 in total) (walking on natural trails, bird watching, spotting wildlife, plant observation, exploring/ visiting caves, climbing/trekking, swimming, camping, campfire, cycling, sailing/boating/kayaking, zipline/canopy tour, fishing)
External access	Distance from the national park to the nearest city of more than 100,000 inhabitants in kilometers: Short (up to 50), Medium (between 50 and 100), and Large (over 100)
Internal assess	Do enterprises contracting/linking to the national park offer internal shuttle services, yes/no?
Local community	Is there a chance to enjoy traditional music/games/cultural activities which will be performed by minorities/local communities when visiting the national park, yes/no?

recreational experience (Findlay and Southwell 2004). Information services, tourism and educational and research cooperation in NPs are also assumed to be important for determining its attractiveness (Dwyer and Kim 2003, Formica and Uysal 2006, Lee et al. 2010) and could create tourism possibilities such as educational tourism in these areas. A variety of recreation activities influence tourists' decisions and their motivation to travel to selected destinations (Formica and Uysal 2006, Saayman and Saayman 2009, Kruger and Saayman 2010, Morrison 2013). The accessibility of the destination (i.e. its internal and external access) may be assessed according to alternative, convenience and distance levels (Deng et al. 2002), which govern the degree of difficulty and convenience of moving from one place to another. Accessibility and transportation is one of the pull factor domains that influence the decisions of tourists to visit protected areas (Kim et al. 2003). Moreover, local communities (e.g. cultural aspect) and peripheral attractions (e.g. importance) are regarded as major elements contributing to the attractiveness of a NP-based tourism destination (Deng et al. 2002, Goodwin 2002).

It is clear from the attribute selection process that protected area-based destinations are complex systems and a range of different attributes may influence the choice

of destination by the tourist, as well as the attractiveness of the destination itself. In this sense, it is necessary to identify the degree to which the selected attributes contribute to the attractiveness of a NP to the tourist in relation to others. Thirteen attributes of a NP (Table 1) were also applied in the selection of Vietnamese NPs for the study.

Data collection

The present study on tourism attractiveness was part of a series of surveys intended for the collection of data related to the management of national parks in Vietnam (*cf.* An et al. 2018). A survey method was used, with a structured questionnaire being sent to the management boards directly responsible for protected area management in 30 Vietnamese NPs (Figure 1). In order to construct the survey questionnaire properly, a mixed-methods approach was undertaken: a review of literature determining the context of protected area management, including tourism activities, was performed (e.g. Puustinen et al. 2009, Lee et al. 2010), followed by discussions with the staff and management boards of the NPs. The survey questionnaire was subsequently pre-tested with six randomly-selected members of management boards. After pre-testing and submitting comments, a structured questionnaire was developed with a total of 26 questions regarding tourism development and management of NPs, among others. After contacting the heads of the management boards in the 30 NPs to explain the purpose of the survey, the questionnaire survey was sent by e-mail between May and December 2016. In addition, the survey was supplemented with phone calls to the respondents to ensure a high rate of response and to gain an insight into the questionnaire. The final response rate to the survey questionnaire was 30/30.

Apart from data survey collection, the study used information collected from secondary data sources (e.g. previous studies and reports) concerning the biodiversity status of protected areas (see Suppl. material 1).

The SMAA and PROMETHEE method

The process of choosing a travel destination can be regarded as a multiple criteria decision analysis problem, whereby destinations are ranked according to the preferences of particular tourists. In such multiple-criteria decision analysis problems (Figueira et al. 2005, Ishizaka and Nemery 2013, Greco et al. 2016), a set of m alternatives

$$A = \{a_1,...,a_i,...,a_m\}$$

is evaluated based on a set of n criteria

$$G = \{g_1,...,g_j,...,g_n\}$$

in order to deal with decision problems such as choosing the best alternative or ranking all alternatives from best to worst. In the case of ranking NP-based tourism attractiveness, the alternatives are Vietnam's national parks (i.e. m = 30 NPs) and the criteria are the attributes according to which these parks would be evaluated (i.e. n = 13 criteria, see Table 1). Let $g_j(a_i)$ denote the evaluation of alternative a_i on criterion g_j. The final ranking will be achieved by aggregating $g_j(a_i)$ properly to tourist preference. The present study applied the PROMETHEE method for modeling the decision process associated with the ranking performed by each tourist before choosing the final NP destination.

The PROMETHEE method is a well-known outranging method (Hyde et al. 2003), and has been widely applied in various disciplines, including tourism planning (Michailidis and Chatzitheodoridis 2006, Kovačić 2010, Muszyńka-Kurnik 2012, Ranjan et al. 2016). Detailed descriptions of PROMETHEE can be found in Brans and Vincke (1985) and Brans and Mareschal (1994, 2005).

The PROMETHEE method acts by developing a preference function

$$P_j(a, b)$$

which is a function of the difference (d_j) between the ratings of two alternatives

$$(a, b) \in A$$

for each criterion *(j)*, i.e.

$$d_j = g_j(a) - g_j(b)$$

where $g_j(a)$ and $g_j(b)$ are performance values of criterion j of two alternatives a and b, and takes values between 0 and 1. For each criterion, a specific preference function (P_j) must be defined, which can be one of six different functions (Brans and Vincke 1985, Brans and Mareschal (2005), see Appendix 1). In order to compare an alternative a with the other alternatives, the single criterion net flow can be calculated as

$$\phi_j(a) = \frac{1}{n-1} \sum_{x \in A} \left[P_j(a,x) - P_j(x,a) \right]$$

and then the net outranking flow can be calculated as

$$\phi(a) = \sum_{j=1}^{k} \phi_j(a)\, w_j$$

where w_j are weights which describe the importance of each criterion for the decision-maker in case of tourists. The final ranking, also known as a complete PROMETHEE II ranking (Brans and Mareschal 2005), is obtained by comparing net outranking

flows for each alternative. The alternative with the highest net outranking flow is considered the preferred one.

The PROMETHEE method can be used in the case of one decision-maker. In this case, the expressed preferences can be described as the individual weight vector, and the set of parameters of the preference function which correspond with the decision maker's own ranking of alternatives. However, to assess the tourism attractiveness of Vietnamese NPs, it is necessary to not only consider the preferences of a single tourist, but also the preferences of each potential tourist visiting NPs. The best way to achieve this is by the stochastic multicriteria acceptability analysis (SMAA) method.

The SMAA method has been developed for discrete multicriteria problems where criteria values and/or weights or other model parameters are not precisely known (Tervonen and Figueira 2008, Lahdelma and Salminen 2010). A number of SMAA methods are known, such as the original SMAA (Lahdelma et al. 1998), SMAA-2 (Lahdelma and Salminen 2001) or SMAA-PROMETHEE (Corrente et al. 2014), which explore the weight space and describe the valuations that would make each alternative solution the most preferred one, or that would give a certain rank for an alternative.

The decision model in the original SMAA method (Lahdelma et al. 1998) considers multiple decision makers, each with a preference parameter representable through an individual weight vector w and a real-valued partial utility function

$$u(a_i, w) = \sum_{j=1}^{n} w_j g_j(a_i)$$

based on these, a ranking of alternatives is constructed. In case of the SMAA-PROMETHEE method, net outranking flows are used instead of utility functions.

The set of all possible weighting vectors is denoted as feasible weight space and defined as

$$W = \left\{ w \in R^n : w \geq 0,\ \sum_{j=1}^{n} w_j = 1 \right\}$$

In addition, a set of favorable rank weights for alternative i is defined as all possible weight vectors for which alternatives i achieved r rank, defined as

$$W_i^r = \left\{ w \in W : \text{rank}\left(i, w\right) = r \right\}$$

where the rank of each alternative is determined as an integer from the best rank (=1) to the worst rank (=m) by means of a ranking function $u\ (a_i, w)$. The ranking function is defined as

$$\text{rank}\ (i, w) = 1 + \sum_{k \neq i} p\left(u\left(a_k, w\right) > u\left(a_i, w\right)\right)$$

where p(true) = 1 and p(false) = 0. Most importantly, the SMAA method outputs descriptive measures such as central weight vectors and rank acceptability indices.

The rank acceptability index can be defined as the ratio between the volume of the set of favorable rank weights and the volume of feasible weight space. This is computed by Monte Carlo simulation as a solution of the multidimensional integral:

$$b_i^r = \int_{w \in W_i^r} f_w(w)\,\mathrm{d}w$$

where f_w (w) is a density function of weight distribution. The rank acceptability indices can be interpreted as a percentage of all possible weight vectors which give alternative i rank r within range [0, 1], where 0 indicates that the alternative will never obtain a given rank and 1 indicates that it will always obtain the given rank with any choice of weights. The most acceptable (best) alternatives are those with high acceptability for the best (smallest) ranks. In the present study, rank acceptability indices were used to measure the tourism attractiveness of NPs. More precisely, the rank acceptability index for rank 1

$$b_i^1 = a_i$$

shows how many possible combinations of weights support the first position in the ranking for a particular NP. In other words, it presents the proportion of different decision makers' preferences to schemes, which result in a particular NP being the most attractive.

The central weight vector is the center of gravity for favorable weights space for rank=1. It is computed as an integral of the weight vector over the criteria and weight distributions as

$$w_i^c = \frac{1}{b_i^1} \int_{w \in W_i} f_w(w)\, w\ \mathrm{d}w$$

With the assumed weight distribution, the central weight vector is the best single vector representation for a decision-maker who supports alternative i (Lahdelma and Salminen 2001). Decision makers can understand which preferences (criteria weights) lead into which actions, without providing any preference information, by presenting the central weight vectors (Tervonen and Figueira 2008).

Statistical analyses and calculations

In the study, the rank acceptability index is considered as an indicator of tourism attractiveness; however, the problem arises as to which rank acceptability indices should be taken into account. The most obvious solution, i.e. the first rank acceptability index, cannot be implemented in cases where only some alternatives are not being dominated. For the dominated alternatives, regardless of weights, there always exists at least one better alternative, and the first acceptability index is equal 0. However, in practice, dominated NPs are chosen as the final destination by some tourists. In order to avoid this paradox, a model of exponential multiple choices is assumed, where some of the tourists

visit more than one NP, and then choose alternatives from the lower ranks as their next destinations for their sets of weights. In addition, it is assumed that the number of tourists who visit more NPs decreases exponentially with the numbers of visited NPs. In this case, it is possible to construct an exponential weighted acceptability index $b_i^{\exp}$ as

$$b_i^{\exp} = \sum_{r=1}^{n} (1-\lambda)\lambda^{r-1} b_i^r$$

where n is the number of alternatives and r is the rank ($r = 1,\ldots,n$), λ is a parameter of the method and b_i^r is the rank acceptability index for rank r and alternative i. Parameter λ is optimized by a maximization of the Spearman's rank correlation coefficient between exponential weighted acceptability indices and the number of tourists visiting NPs in 2015.

The PROMETHEE method was used to model the ranking process made by each tourist before choosing the destinations. To unify and simplify the model, two types of preference function were applied for the ranking process: usual and linear types. While both types depend on particular criteria, the usual types (Type 1, see Appendix 1) are associated with discrete variables and the linear types (Type 3, see Appendix 1) with continuous variables. For the linear type of general criterion, the threshold of strict preference p has been chosen as a maximum difference between the performance values of alternatives. One exception from this rule has been made for values of tourism cooperation criterion, where the strict preference threshold was set at 25 by expert judgment; this was agreed in response to the overwhelming dominance of Phong Nha - Ke Bang NP and the specification of the criterion for better description of potential preferences. The decision matrix for the tourism performance appraisal of 30 NPs can be found in Appendix 2, and a detailed assumption for NP selection in Appendix 3.

In addition, descriptive measures of SMAA computations are calculated by considering the number of Monte Carlo replications performed in order to obtain a sufficiently accurate approximation (Tervonen and Figueira 2008, Lahdelma and Salminen 2010). For example, an error limit of 0.01 can be accomplished with 95% confidence by performing approximately 10,000 replications (Lahdelma and Salminen 2010). In the present paper, 100,000 replications were generated in order to obtain rank acceptability indices and central weight vectors.

All calculations and statistical analyses in the study were performed using the software package R, version 3.3.3 (R Core Team 2017).

Results

National parks' characteristics

The 30 Vietnamese NPs differ markedly in terms of size, designation, geographical distribution and number of tourists (Table 2). Many NPs or NP areas were also specified under international and regional agreements, including the international designations (Ramsar Site, United Nations Educational, Scientific and Cultural Organisation

Table 2. Vietnamese national parks.

National parks	Year of establishment	Area (ha)	Other designation	Vietnam geographical region	Tourists by years	
					2005	2015
Hoang Lien	2002	28.059	AHP	NW	–	116.305
Ba Be	1992	10.048	RS, AHP	NE	–	45.000
Xuan Son	2002	15.048	–	NE	500	21.780
Cuc Phuong	1962	22.200	–	RRD	63.258	71.600
Cat Ba	1986	17.363	UBR, MPA	RRD	57.000	412.346
Ba Vi	1991	10.815	–	RRD	–	216.050
Tam Dao	1996	34.995	–	RRD	–	14.176
Bai Tu Long	2001	15.783	MPA	RRD	–	12.838
Xuan Thuy	2003	7.100	RS	RRD	3.990	16.482
Bach Ma	1991	37.487	–	NCC	8.926	14.852
Ben En	1992	14.735	–	NCC	–	9.892
Pu Mat	1997	91.113	UBR	NCC	7.837	4.186
Phong Nha – Ke Bang	2001	123.326	UWHS	NCC	255.923	714.835
Vu Quang*	2002	57.038	UBR	NCC	–	–
Cat Tien	1992	72.634	UBR, RS	CH	16.043	26.664
Yok Don	1992	115.545	–	CH	–	1.760
Chu Mom Ray*	2002	56.621	AHP	CH	–	–
Kon Ka Kinh*	2002	42.143	AHP	CH	–	–
Chu Yang Sin	2002	58.971	–	CH	–	30.000
Bidoup-Nui Ba	2004	70.038	UBR	CH	–	7.442
Nui Chua	2003	29.865	MPA	SCC	–	530
Phuoc Binh	2006	19.814	–	SCC	–	1.200
Con Dao	1993	20.000	RS, MPA	SE	–	19.753
Bu Gia Map	2002	25.779	–	SE	–	1.239
Lo Go – Xa Mat	2002	19.156	–	SE	–	3.369
Tram Chim	1998	7.588	RS	MRD	–	175.208
Phu Quoc*	2001	29.421	UBR, MPA	MRD	–	–
U Minh Thuong	2002	8.038	UBR, RS, AHP	MRD	–	50.040
Mui Ca Mau	2003	41.862	UBR, RS	MRD	–	109.372
U Minh Ha	2006	8.528	UBR	MRD	–	16.886

List of abbreviations: UWHS: United Nations Educational, Scientific and Cultural Organisation World Heritage Site; UBR: United Nations Educational, Scientific and Cultural Organisation Biosphere Reserve; RS: Ramsar Site; AHP: Association for Southeast Asian Nations Heritage Park; MPA: Marine Protected Area. NW: North West; NE: North East; RRD: Red River Delta; NCC: North Central Coast; CH: Central Highlands; SCC: South Central Coast; SE: South East; MRD: Mekong River Delta

*At the time of the study, visitor statistics were not available; – Lack of data

[UNESCO] World Natural Heritage Site and UNESCO Biosphere Reserve), as well as regional designations including the Association for Southeast Asia Nations Heritage Parks. Some NPs were listed in the system of Marine Protected Areas.

In the context of tourism development, the majority of NPs (87%) administered tourism activities (Table 2), which generated a significant source of funds for protected areas. Over the past decade, the total number of tourists visiting NPs has risen even more steeply, i.e. by over 500%, reaching 2,113,805 in 2015. It was found that Phong Nha – Ke Bang NP attracted the highest number of tourists in 2015, with a total of 714,835 tourists.

Ranking of tourism performance of Vietnamese national parks

The obtained rank acceptability indices, calculated according to the SMAA-PROMETHEE method, for 30 Vietnamese NPs are presented in Table 3 (see Suppl. material 2). It was found that Phong Nha - Ke Bang NP is the most attractive of all tested parks in Vietnam over the widest range of preference structure. Phong Nha – Ke Bang NP has about 70% of possible preference structures, making it the most preferred. The second and third most attractive NPs were found to be Cuc Phuong and Ba Be, with 20% and 6% of possible weight structures respectively. In total, Phong Nha - Ke Bang, Cuc Phuong and Ba Be NPs appear to be the most attractive to tourists, with more than 95% of all possible preference structures. In addition to the results, 18 NPs were dominated by the other 12 NPs (Table 3). Hence, there would be always at least one NP which is more interesting regarding tourism attractiveness, regardless of tourist preference structure.

Since 18 NPs were dominated (Table 3), they have no central weight vectors. For the remaining 12 NPs (i.e. non-dominated NPs), central weight vectors can be calculated (Appendix 4). A graphical representation of central weight vectors (Figure 2 and Appendix 4) as well as the importance of each criterion among all other criteria (Table 4 and Appendix 4) clearly describe the average preferences of a particular NP visitor. In particular, the criterion of trails was the most, or almost one of the most, important criteria for supporters of all non-dominated NPs, except for Cat Tien and Phong Nha – Ke Bang NPs.

Spearman's rank correlation coefficient was employed to assess the correlation between tourism attractiveness and the number of tourists who visited the NPs. The comparison was carried out for only 26 NPs due to a lack of data on the number of tourists of four NPs (Table 2). The maximum achieved Spearman's rank correlation coefficient between the number of tourists and exponential weighted acceptability index was 0.285 (p = 0.173) for λ between 0.137 and 0.146. In other words, 13 criteria taken into consideration were able to describe the tourist attractiveness of NPs with 28.5% probability, and it was found to be statistically significant at the p=0.05 level. The low value of λ (0.137) indicates that the proportion of tourists visiting only a single NP is around 85%.

Discussion

National parks in Vietnam are an essential part of the national development strategy for the countryside, as well as nature protection (PARC Project 2006). Hence, effective planning and management of tourism in NPs is crucial in order to ensure sustainable conservation of natural resources, achievement of long-term objectives of protected area management, and ready adaptation to national, regional and local development plans (Eagles et al. 2001, 2002). It is also essential to consider the characteristics of NBT destinations when supporting the management plans of protected areas (Puustinen et al. 2009).

Table 3. Rank acceptability indices for Vietnamese national parks.

National Park	Rank acceptability index for rank (%)					Sum of rank acceptability indices for ranks (%)		
	1	2	3	4	5	6–10	11–20	21–30
Phong Nha - Ke Bang*	70.423	14.702	6.944	3.004	1.767	2.723	0.437	0.000
Cuc Phuong*	20.324	31.976	20.639	11.963	6.431	8.451	0.216	0.000
Ba Be*	5.462	28.521	28.774	17.852	9.651	9.598	0.142	0.000
Hoang Lien*	1.234	9.995	13.454	15.471	16.155	40.133	3.556	0.002
Bidoup-Nui Ba*	1.077	2.891	4.755	7.751	12.613	64.718	6.195	0.000
Tam Dao*	0.839	1.990	3.269	6.418	9.663	65.159	12.558	0.104
Cat Ba*	0.609	3.877	5.521	9.399	11.800	59.309	9.485	0.000
Cat Tien*	0.091	5.051	13.072	20.088	15.629	38.939	7.127	0.003
Nui Chua*	0.005	0.038	0.124	0.335	0.550	26.944	70.294	1.710
Chu Yang Sin*	0.002	0.006	0.008	0.023	0.052	2.558	63.348	34.003
Ba Vi*	0.001	0.958	3.015	6.510	12.676	69.963	6.869	0.008
Pu Mat*	0.001	0.046	0.410	1.100	2.655	54.713	39.827	1.248
Bach Ma	0.000	0.000	0.001	0.003	0.005	13.794	85.111	1.086
Bai Tu Long	0.000	0.000	0.000	0.000	0.001	0.672	51.102	48.225
Ben En	0.000	0.000	0.000	0.000	0.008	9.162	84.733	6.097
Bu Gia Map	0.000	0.000	0.005	0.030	0.189	12.980	82.180	4.616
Chu Mom Ray	0.000	0.000	0.000	0.000	0.000	0.000	0.082	99.918
Con Dao	0.000	0.000	0.000	0.000	0.000	0.000	9.928	90.072
Kon Ka Kinh	0.000	0.000	0.000	0.000	0.000	0.000	0.865	99.135
Lo Go - Xa Mat	0.000	0.001	0.005	0.005	0.013	1.321	59.968	38.687
Mui Ca Mau	0.000	0.000	0.000	0.000	0.001	0.442	16.413	83.144
Phu Quoc	0.000	0.000	0.000	0.000	0.000	0.142	22.698	77.160
Phuoc Binh	0.000	0.000	0.000	0.001	0.002	1.992	70.258	27.747
Tram Chim	0.000	0.000	0.000	0.002	0.002	1.324	56.475	42.197
U Minh Ha	0.000	0.000	0.000	0.000	0.000	0.014	3.653	96.333
U Minh Thuong	0.000	0.000	0.000	0.000	0.000	0.321	49.391	50.288
Vu Quang	0.000	0.000	0.000	0.001	0.002	0.260	24.251	75.486
Xuan Son	0.000	0.000	0.000	0.000	0.000	0.000	3.279	96.721
Xuan Thuy	0.000	0.000	0.004	0.042	0.118	11.576	77.054	11.206
Yok Don	0.000	0.000	0.000	0.000	0.003	2.734	82.545	14.718

* National parks were not dominated

The present study explores some of the attributes and characteristics of NPs associated with the initial evaluation of tourism attractiveness and destinations in 30 Vietnamese NPs. The findings not only contribute to a deeper understanding of the managerial context of NPs, but also provide information on the performance appraisal of NPs with regard to tourism. The study highlights the relative importance of attributes with regard to the tourism attractiveness of NP-based destinations and orders them into a ranking system.

The ranking of the national parks by the SMAA and PROMETHEE model suggests a degree of competition exists regarding the tourism attractiveness and tourism performance of protected areas. Our present findings indicate that Phong Nha - Ke Bang NP has the most competitive position. Phong Nha - Ke Bang is situated in Central Vietnam, 40km north of Dong Hoi City (Quang Binh Province) and 500km south of Ha Noi City, and possesses outstanding historical and cultural resources such as cave systems and indig-

Table 4. The importance of criteria supporting particular national parks. The heat map represents the average proportional relative importance of each criterion to a national park supporter, with the scale ranging from green (the least important) to red (the most important).

National park	IN	BD	RR	HS	HH	IS	TR	TC	EC	DA	EA	IA	LC
Phong Nha – Ke Bang	2	10	4	7	11	12	13	5	3	6	1	9	8
Cuc Phuong	13	4	11	7	3	2	1	5	10	9	12	6	8
Ba Be	2	11	5	6	4	1	3	13	9	10	12	8	7
Hoang Lien	11	4	6	7	12	9	1	8	3	10	2	13	5
Bidoup-Nui Ba	2	8	10	13	9	12	1	6	7	11	3	5	4
Tam Dao	11	9	6	4	8	3	1	10	13	7	2	5	12
Cat Ba	4	10	11	6	7	8	1	13	9	2	3	5	12
Cat Tien	2	8	12	13	9	1	11	7	3	5	10	4	6
Nui Chua	10	8	12	8	6	5	1	11	7	13	2	3	4
Chu Yang Sin	9	11	2	3	9	13	1	7	6	5	11	8	4
Ba Vi	10	8	10	6	7	10	2	8	1	4	5	2	10
Pu Mat	1	4	12	5	7	3	2	6	10	7	7	12	10

List of abbreviations: IN: International importance; BD: Biodiversity of plants and animals; RR: Rare plants and animals; HS: Historical, cultural and spiritual structures; HH: Hotels & hostels; IS: Information services; TR: Trails; TC: Tourism cooperation; EC: Education & research cooperation; DA: Diversity of outdoor activities; EA: External access; IA: Internal access; LC: Local community.

enous groups (UNESCO 2014). Phong Nha - Ke Bang NP dominates other NPs: it had the highest acceptability index (70%) for the best rank, fairly high acceptability for the second and third ranks, and almost zero acceptability for ranks four to thirty (Table 3).

The competitiveness of NPs in Vietnam appears uneven: while the three best NPs (Phong Nha – Ke Bang, Cuc Phuong, and Ba Be) were the most attractive for 95% of potential tourists, 60% of NPs were dominated by the best NPs and were not able to compete effectively with them. According to the Vietnam tourism master plan until 2020 (GoV 2013), over half of the 12 identified non-dominated NPs (e.g. Phong Nha - Ke Bang, Cuc Phuong, Ba Be, Hoang Lien, Cat Tien, Tam Dao, Ba Vi) were considered tourist sites (zones) and were prioritized by investment projects for the development of national tourism. It is also important to consider these 12 NPs when developing nature-based tourism strategies or plans at regional and national levels.

It was found that each criterion (attribute) contributed a different value towards the attractiveness of the 12 non-dominated NPs (Figure 2, Tables 3, 4). The results are in line with those of Deng et al. (2002) and Lee et al. (2010), who found that selected criteria did not contribute equally to the weights determining attractiveness. The obtained central weights reveal the preferences of a potential tourist who visits a certain NP, and indicate the advantages and disadvantages of all 12 NPs (Figure 2, Table 4). Contrary to Deng et al. (2002), natural characteristics, such as biodiversity or rare species of animals and plants, were not considered to be the most important criteria supporting the attractiveness of a particular NP for tourists, which suggests that it is necessary to consider the knowledge and perspectives of both experts and tourists when making a decision. However, there is currently no shared biodiversity database or any biodiversity monitoring system applied to protected areas. These deficiencies constitute one of multiple

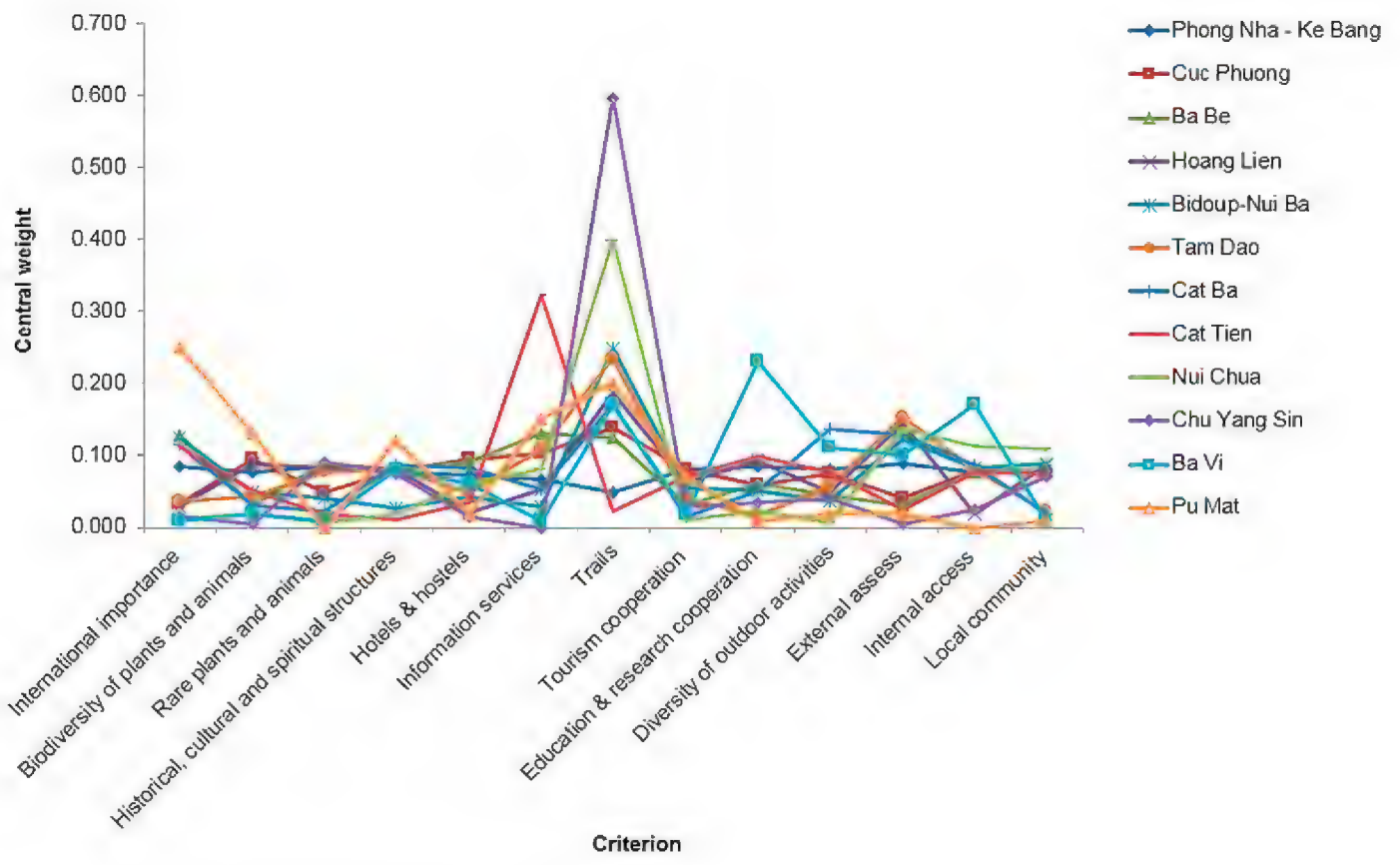

Figure 2. Central weight vectors of national parks.

challenges faced by decision makers regarding the sustainable development of natural resources and effective protected area management in Vietnam (MONRE 2011, 2014). Increasing the amount of available information regarding the updated biodiversity status of protected areas could improve the tourism attractiveness of particular NPs such as Ba Vi and Nui Chua (Table 4). In particular, NPs should highlight their unique and rare natural assets, such as flagship and iconic species, in order to distinguish them from other NP-based destinations. Even highlighting the engagement of organizations in conservation initiatives could become a valuable part of marketing activities for species and nature-based tourism experiences in protected areas (Ballantyne et al. 2009).

The trail criterion identified in the present findings plays a crucial role for supporters of most non-dominated parks; hence the trail attribute appears to be the most important of the recreation facilities affecting forest-based tourism attractiveness (Lee et al. 2010). As recreational facilities within NPs, trails are an attraction for both casual and serous hikers and may take tourists into a range of areas, such as natural ecosystems and the primitive interior of protected areas (Manning and Anderson 2012), and provide opportunities for a variety of outdoor recreation activities, such as walking and hiking. The high importance of the trail criterion was also connected with the fact that it is a weak point of Phong Nha - Ke Bang. In this sense, tourists who are attracted by long-distance trails are more likely to prefer other NPs, such as Chu Yang Sin NP (Figure 2, Table 4). NP managers should consider designing, developing and planning recreational trail networks for tourists that could help them appreciate natural resources or most attractive parts of NPs, provide and operate health enhancement facilities, and offer various levels and durations of experience (Eagles et al. 2001, 2002, Kim et al. 2003).

Moreover, it was found that other criteria with discriminating power were its international importance -this being the most important criterion for Pu Mat. Information services was a significant criterion for Ba Be, Cat Tien and Cuc Phuong. Education and research cooperation was the most important criterion for Ba Vi, and external access was the important criterion for Phong Nha - Ke Bang, Hoang Lien, Tam Dao and Nui Chua (Table 4). As one of the labels, or intangible elements, the international importance of an NP or NP areas is regarded as playing an important role in increasing its attractiveness and its successful marketing (Palmer 1999); for example, recognition as a UNESCO World Heritage site is believed to draw millions of tourists to these sites (Yan and Morrison 2008). To attract tourists, NP managers (i.e. marketers) of internationally recognized sites should promote them as such in the mass media and guidebooks, and compare them with other NPs, e.g. Phong Nha - Ke Bang is the only NP under the UNESCO World Heritage List (see Table 2). The development of information services in NPs reflect partly the investment in the tourism infrastructure of a destination, but also contribute toward improving destination repositioning and may significantly increase tourist flows to protected areas (Puustinen et al. 2009, Castro et al. 2015). Extending education and research cooperation with domestic schools and universities also encourages the growth of educational tourism in Vietnam's NPs; for example, by organizing educational tourism activities for students. Many of the domestic tourists visiting protected areas are students on school or university outings, and there is great potential for developing environmental education activities for them (ICEM 2003). Tourism cooperation, as one of the key components of the nature tourism industry, encourages tourists to visit destinations and promotes more positive images of destinations (Higgins 1996, Carey et al. 1997, Cavlek 2002, Dwyer and Kim 2003). The degree of external access to protected areas is influenced by the state of the public transportation infrastructure and multimodal transport in the region. Tourists will seek alternative destinations if accessibility to a preferred tourism destination is limited, for example by comfort levels and journey time in the transport system (Prideaux 2000).

Our present findings also suggest that the development of NP-based tourism destinations in Vietnam is uneven. In particular, the development of tourism in protected areas, where most NPs suffer from a lack of services and facilities for tourism, is faced by multiple challenges; several NPs are characterised by logging and unavailable trails (see Appendix 2). The issues are similar to those identified by the PARC Project (2006), which found that more than 60% of the state budget of the Vietnamese Government for protected areas went to infrastructure development. On the other hand, most NPs spent about half of their funds on conservation activities, and financial allocations for protected area management could also change over time (An et al. 2018). In this context, considering the allocation of financial sources and investment in tourism, particularly in tourism infrastructure, would be an effective contribution to the management of tourism in NPs. This would also help NP managers create a sound investment plan for their priority actions, such as trails/recreational facilities.

The tourism attractiveness of a NP, i.e. its attractiveness to tourists, significantly correlated with the number of tourists visiting it. This was consistent with the result for

Phong Nha - Ke Bang NP, which was rated as the most attractive park and attracted the highest number of tourists in 2015 (Table 2). However, despite receiving a high number of tourists, some protected areas such as Mui Ca Mau, Tram Chim and U Minh Thuong NPs were assigned low acceptability indices to higher ranks, as low competitive strengths; for example, with a high number of 109,372 tourists in 2015, Mui Ca Mau had the highest acceptability (83%) for the 21–30 rank (Tables 2, 3). Hence, only about 29% of the criteria in the model explained the level of tourism attractiveness with respect to the tourist numbers. In other words, apart from 13 selected criteria in the study, NP tourism attractiveness could be predicted through other criteria, such as population density and tourist services outside the NP (Puustinen et al. 2009, Castro et al. 2015). Contrary to Mui Ca Mau NP, Bidoup-Nui Ba was found to be an attractive destination, but only about 7,500 tourists visited the park in 2015 (Tables 2, 3). This suggests that Bidoup-Nui Ba managers should promote marketing activities to highlight their potential advantages (i.e. trails, external access, international importance, and local community) and attract more tourists.

In addition to its methodological qualities, the results indicate that integrating the SMAA and PROMETHEE methods could serve as a useful approach for supporting decision making when ranking NP-based tourism destinations, and provide decision makers with information for determining the position of a destination. However, it may not be realistic to develop a decision model that fits all decision makers and every decision situation (Sirakaya and Woodside 2005). Although the main purpose of a NP is to protect nature and provide recreation possibilities, each NP has different objectives for natural resource management and tourism development. In this context, further research regarding the various aspects of decision making is necessary when making trade-offs between nature protection and tourism development in protected area management. Such trade-offs and conflicts between stakeholders are common, and the conservation of species and habitats and other natural values and the intensity in both of them tend to increase when a protected area-based destination becomes more attractive to tourists. For example, the most common basic sources of tension appear to occur between operators seeking greater and closer access to wildlife and the protected area managers seeking to restrict access and increase the distance between visitors and species (Reynolds and Braithwaite 2001). The conflict between the need to protect the ecological integrity of an area and to provide facilities for visitors requires careful management and long-term monitoring of tourist impact (Goodwin 1996). Moreover, trade-off analysis could bring together diverse quantitative and qualitative information for decision making, thus allowing tourism development options to be ranked on the basis of different stakeholder values (Brown et al. 2001).

In trying to evaluate the attractiveness and the performance of 30 Vietnamese NPs in the context of NBT management, the present study was limited to criteria that are easily measured. Other attributes of a protected area, such as image, climatic phenomena, landscapes and scenery, can be assumed to affect the tourism attractiveness and destination choice (Dwyer and Kim 2003, Hsu et al. 2009, Lee et al. 2010), but were not included in the present analysis. Even Lee et al. 2010 found that the uniqueness

of forest landscapes and scenery and special climate phenomena are two of the most important attributes determining the attractiveness of forest-based tourism. In this sense, the beautiful scenic mountain landscapes of many Vietnamese NPs situated in relatively remote areas may have an influence over their tourism attractiveness and their tourist flows. The aesthetic of a tourism destination should also be considered when evaluating the tourist experience, as it has been found to be the most important factor for tourists (Dodds et al. 2010). In other words, a variety of diagnostic attributes that may affect the attractiveness of a NP directly and indirectly, as well as the implementation of tourism should be appraised for further study.

Furthermore, the present study lacks the perspective of decision makers or different stakeholders; for example, domestic and foreign tourists who not only directly use the natural resources of a NP but also can evaluate its attributes as a destination (Michailidis and Chatzitheodoridis 2006, Hsu et al. 2009). It is important to consider expert opinions when determining attributes and their relative importance (Lee et al. 2010), particularly in the context of managing the natural resources of protected areas, and their values and assets which could be essential when performing multi-criteria analyses and evaluating NP-based tourism destinations. In addition, the study does not examine perceptions or attitudes of tour operators and travel agencies; tour operators have considerable influence on the choice of travellers, tourism strategies, and the development plans of tourism destinations (Carey et al. 1997, Sigala 2008).

These approaches raise some key questions, e.g. how to use potential NP attributes to attract tourists, how to determine the attractiveness of NP-based tourism, how to involve stakeholders and evaluate their role in the tourism management of NPs, how NBT can be developed while maintaining a high level of ecosystem and biodiversity. Although the precise answers to these questions remain unclear, the approach taken in the present study is an effective method of evaluating the characteristics of NPs and their tourism performance. Such evaluation represents a crucial step in addressing these questions, as well as in improving the effective management of protected areas. Taking this approach will allow more effective planning and development of protected area-based tourism and sustainable tourism in Vietnam.

Conclusion

SMAA and PROMETHEE have been widely applied to deal with various real-world problems (Hyde et al. 2003, Brans and Mareschal 2005, Tervonen and Figueira 2008). The present study used an integration of SMAA and PROMETHEE methods, and it proposed a new index (i.e. the exponential weighted acceptability index) for the measurement of NP tourism attractiveness. Our findings indicate that Phong Nha - Ke Bang, Cuc Phuong and Ba Be NPs gave the best performance of 30 studied national parks in Vietnam, with respect to tourism attractiveness. In addition, 12 NPs were found to be non-dominated, and the trail criterion appears to be the most important central weight vector supporting most of these parks. A statistically significant correlation was also

found between the tourism attractiveness of a national park and the number of tourists visiting it. However, improving tourism attractiveness should not only aim at increasing tourist flows to a national park. It should also facilitate the development of sustainable nature-based tourism and the main objectives of national parks. Further studies can build upon the present findings to obtain more precise strategies for fostering NP-based tourism in order to improve the effectiveness of management of national parks, and promote sustainable development of NBT in protected areas in Vietnam.

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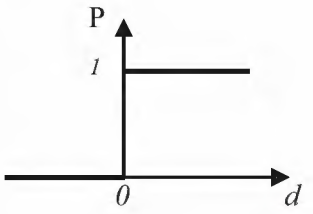
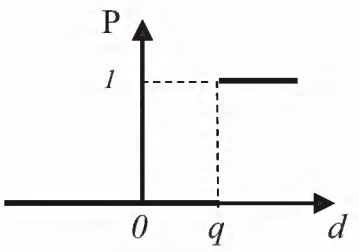
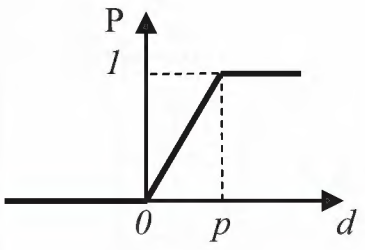
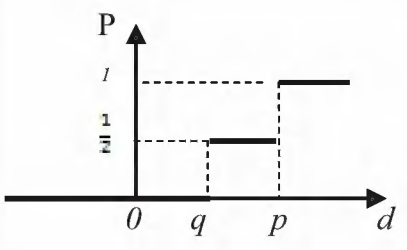
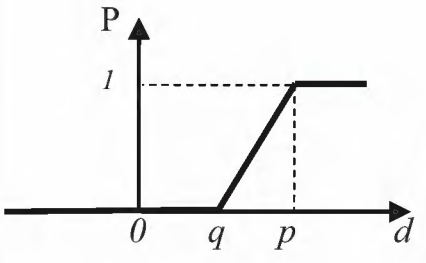
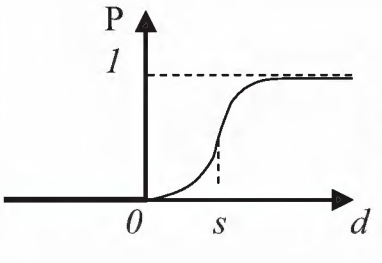
Appendix I

Types of generalized criteria and their corresponding preference functions. Source: Adapted to Brans and Mareschal (2005).

Name of the Criterion	Preference function	Parameters
Type 1: Usual Criterion	 $P(d) = \begin{cases} 0 & d \le 0 \\ 1 & d > 0 \end{cases}$	None
Type 2: U-shape Criterion	 $P(d) = \begin{cases} 0 & d \le q \\ 1 & d > q \end{cases}$	q
Type 3: V-shape Criterion with linear preference	 $P(d) = \begin{cases} 0 & d \le 0 \\ \dfrac{d}{p} & 0 \le d \le p \\ 1 & d > p \end{cases}$	p
Type 4: Level Criterion	 $P(d) = \begin{cases} 0 & d \le q \\ \dfrac{1}{2} & q \le d \le p \\ 1 & d > p \end{cases}$	p, q
Type 5: V-shape Criterion with indifference and linear preference	 $P(d) = \begin{cases} 0 & d \le q \\ \dfrac{d-q}{p-q} & q < d \le p \\ 1 & d > p \end{cases}$	p, q
Type 6: Gaussian Criterion	 $P(d) = \begin{cases} 0 & d \le 0 \\ 1 - e^{-\frac{d^2}{2s^2}} & d > 0 \end{cases}$	s

Appendix 2

Decision matrix for the tourism performance appraisal of Vietnamese national parks. List of abbreviations: IN: International importance; BD: Biodiversity of plants and animals; RR: Rare plants and animals; HS: Historical, cultural and spiritual structures; HH: Hotels & hostels; IS: Information services; TR: Trails; TC: Tourism cooperation; EC: Education & research cooperation; DA: Diversity of outdoor activities; EA: External assess; IA: Internal access; LC: Local community.

National park	Criteria												
	IN*	BD**	RR**	HS*	HH*	IS*	TR*	TC*	EC*	DA*	EA*	IA*	LC*
Ba Be	1	2536	153	1	300	7	9	5	9	7	2	1	1
Ba Vi	0	3075	137	1	160	4	6	5	10	9	3	1	0
Bach Ma	0	3669	148	1	44	4	7.7	1	5	5	2	1	0
Bai Tu Long	0	1111	108	0	0	7	0	0	4	5	3	1	0
Ben En	0	2734	94	1	160	6	5	0	2	6	3	0	0
Bidoup-Nui Ba	1	2680	109	0	60	4	41.1	8	6	6	3	1	1
Bu Gia Map	0	1874	97	1	48	5	39.5	0	5	5	1	1	1
Cat Ba	1	2329	94	1	256	6	24.3	0	7	11	3	1	0
Cat Tien	1	3139	117	0	130	7	0	28	12	9	2	1	1
Chu Mom Ray	0	2142	81	0	0	3	0	0	0	2	2	0	0
Chu Yang Sin	0	1402	106	1	0	2	78	1	0	6	2	0	1
Con Dao	0	1212	28	0	48	4	8.4	1	3	6	1	0	0
Cuc Phuong	0	4510	125	1	380	7	35	50	8	9	2	1	1
Hoang Lien	0	3795	150	1	40	6	27	26	10	7	3	0	1
Kon Ka Kinh	0	1578	69	0	0	3	0	0	1	1	3	0	0
Lo Go - Xa Mat	0	1236	35	1	20	4	60	0	3	6	3	0	0
Mui Ca Mau	1	439	28	1	0	2	0	0	0	7	1	0	1
Nui Chua	0	1834	76	0	60	5	46	7	3	4	3	1	1
Phong Nha – Ke Bang	1	3774	195	1	170	6	0	300	13	10	3	1	1
Phu Quoc	1	1561	65	1	0	0	0	0	7	6	1	0	0
Phuoc Binh	0	1552	86	0	50	2	3	10	4	4	3	0	1
Pu Mat	1	3764	150	1	72	7	15	2	5	5	1	0	0
Tam Dao	0	2581	148	1	120	7	44	5	0	7	3	1	0
Tram Chim	1	545	52	0	24	2	0	2	4	6	3	1	0
U Minh Ha	1	374	28	0	30	2	0	0	3	4	3	0	0
U Minh Thuong	1	682	40	0	20	3	5	3	5	5	2	1	0
Vu Quang	1	2508	184	0	0	1	0	0	4	3	2	0	0
Xuan Son	0	2226	117	0	0	4	0	0	0	3	2	0	0
Xuan Thuy	1	756	11	1	30	5	0	15	9	5	2	1	0
Yok Don	0	1388	80	0	42	6	39	5	0	5	2	1	1

Sources: *Survey data (2016); **Suppl. material 1

Appendix 3

Assumptions for national park selection.

Criteria	Value	Preference function	*q*	*p*	Max/Min
International designation	1 = Yes, 0 = No	Usual	0	1	Max
Biodiversity of plants and animals	Numeric variables	Linear	0	4136	Max
Rare plants and animals	Numeric variables	Linear	0	184	Max
Historical, cultural and spiritual structures	1 = Yes, 0 = No	Usual	0	1	Max
Hotels & hostels	Numeric variables	Linear	0	380	Max
Information services	Numeric variables	Linear	0	7	Max
Trails	Numeric variables	Linear	0	78	Max
Tourism cooperation	Numeric variables	Linear	0	25	Max
Education & research cooperation	Numeric variables	Linear	0	13	Max
Diversity of outdoor activities	Numeric variables	Linear	0	10	Max
External access	3 = Short, 2 = Medium, 1 = Large	Level	0	1	Max
Internal assess	1 = Yes, 0 = No	Usual	0	1	Max
Local community	1 = Yes, 0 = No	Usual	0	1	Max

Appendix 4

Central weight vectors. List of abbreviations: IN: International importance; BD: Biodiversity of plants and animals; RR: Rare plants and animals; HS: Historical, cultural and spiritual structures; HH: Hotels & hostels; IS: Information services; TR: Trails; TC: Tourism cooperation; EC: Education & research cooperation; DA: Diversity of outdoor activities; EA: External assess; IA: Internal access; LC: Local community.

National park	IN	BD	RR	HS	HH	IS	TR	TC	EC	DA	EA	IA	LC
Phong Nha – Ke Bang	0.085	0.077	0.084	0.077	0.073	0.066	0.048	0.081	0.085	0.081	0.088	0.077	0.077
Cuc Phuong	0.034	0.094	0.049	0.078	0.095	0.103	0.139	0.080	0.058	0.074	0.041	0.079	0.077
Ba Be	0.128	0.032	0.089	0.081	0.090	0.131	0.125	0.032	0.060	0.044	0.032	0.077	0.079
Hoang Lien	0.029	0.088	0.083	0.081	0.022	0.053	0.187	0.063	0.093	0.048	0.145	0.020	0.087
Bidoup-Nui Ba	0.125	0.049	0.041	0.027	0.042	0.030	0.249	0.055	0.050	0.038	0.123	0.083	0.089
Tam Dao	0.037	0.043	0.077	0.081	0.048	0.108	0.235	0.040	0.018	0.056	0.152	0.081	0.024
Cat Ba	0.115	0.031	0.023	0.086	0.083	0.053	0.170	0.016	0.050	0.136	0.128	0.087	0.020
Cat Tien	0.112	0.050	0.019	0.012	0.036	0.323	0.024	0.070	0.098	0.076	0.026	0.077	0.075
Nui Chua	0.014	0.020	0.008	0.020	0.060	0.080	0.398	0.012	0.024	0.008	0.136	0.112	0.108
Chu Yang Sin	0.015	0.005	0.090	0.075	0.015	0.000	0.595	0.030	0.035	0.040	0.005	0.025	0.070
Ba Vi	0.010	0.020	0.010	0.080	0.060	0.010	0.170	0.020	0.230	0.110	0.100	0.170	0.010
Pu Mat	0.250	0.130	0.000	0.120	0.020	0.150	0.200	0.070	0.010	0.020	0.020	0.000	0.010

Supplementary material 1

Biodiversity in Vietnam's national parks

Authors: Le Thanh An, Janusz Markowski, Maciej Bartos, Agnieszka Rzenca, Piotr Namiecinski

Data type: species data

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Link: https://doi.org/10.3897/natureconservation.32.30753.suppl1

Supplementary material 2

Rank acceptability indices for 30 national parks in Vietnam

Authors: Le Thanh An, Janusz Markowski, Maciej Bartos, Agnieszka Rzenca, Piotr Namiecinski

Data type: species data

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